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A Review of Current Graduate and Research Activities

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BOSTON UNIVERSITY

GRADUATE JOURNAL

A Review of Current Graduate and Research Activities

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Are References Necessary?

NORMAN H. ABBOTT, *Associate Professor, Director of Placement Service*

DURING the past few years, written references have declined in popularity among many employers in the market for new personnel. A glance at the hundreds of written recommendations that pour into our placement offices each year would furnish the reason for this prejudice. You will find in roughly one-quarter of these letters words like "loyal," "industrious," "dependable," "honest," "tactful," and "capable" eulogizing the prospective employee without any evidence backing up such glowing adjectives.

"Letters of recommendation are almost always useless," the director of a large electronics corporation said recently. "It is apparent that an employee will not ask for a letter of recommendation from anyone who will not give him a fairly clean bill of goods."

One often overlooked shortcoming of such complimentary back-slapping references is their placement of the potential employee in an uncompromising position. The reference may be instrumental in getting him the job, but once hired, he is obligated in the eyes of many an employer to show "the proof of the pudding."

IT may be said that references are not useful *per se*, but have a *per quod* value. They furnish the employer with a basis of fact upon which he can build an investigation. As the sales manager of a large national organization has told me, "We ask for them [references], but they are primarily used for furthering our investigation....We find that checking the statements in the written recommendation is valuable when we have the opportunity to telephone or interview the [former] employer."

There is also a psychological factor involved in the writing and reading of references. The conscientious reference writer, wishing to give his friend the best possible recommendation without misrepresentation, generally stresses his subject's best selling points, and remains silent about any known shortcomings. The job of rating the individual through his letter becomes a matter of reading between lines, searching for items that are "conspicuous by their absence."

A WELL-WRITTEN reference, moderate in tone, with only significant information, is achieved partly

through the initiative of the individual job-hunter. Not many employers (nor many instructors, either) can say that they intimately know every man under their supervision. When considering possible reference persons, the individual should always obtain permission before using anyone as a reference; at that time, a brief reminder of the particular details of the relationship between the applicant and his reference might help the friend to recall the personality and achievements of the individual in question.

A well-written reference featuring a balanced appraisal of the individual can become a veritable stepping-stone to employment if it is properly used. I have found that the majority of references that cross my desk each year meet all the requirements of a good letter of recommendation.

WRITTEN references fall into four categories: *employer*, *personal*, "*to whom it may concern*," and *academic*.

Employer references — statements from men who have valid information about the on-the-job experience, personal qualities, and accomplishments of their employees — are the most common type of reference and, if carefully constructed, can give another employer a good insight into the character and abilities of the individual. In a large firm, comments from immediate supervisors and department heads who have had day-to-day contact with the employee can help buttress the effectiveness of the reference.

The applicant should be wary of seeking statements from large companies maintaining central personnel records, unless he does so primarily for the purpose of verifying employment dates. Company references received through such departments often give only the bare details of employment. A typical statement from a personnel office might read as follows:

HIRED	OCCUPATION
11-20-46	Time Study Clerk
RELEASED	REASON
8-8-49	Reduction in Force

Personal references are requested from clergymen, fellow employees, and other close friends of long standing who are able to give an evaluation of a man's character and personality. Many employers question the value of the personal recommendation, since only those people who will give favorable comments are usually selected.

"*To whom it may concern*" recommendations are the weakest type of personal evaluation statement. The opinion of the writer may be used as long as the job hunter carries it on his person. In the space of several years, great changes may take place in the applicant's character, rendering him unsuitable to almost any employer; yet he is always able to produce a complimentary letter, wrenching it from its original frame of reference and injecting it into current situations where no valid application exists. In fairness to himself, the writer that accommodates a close friend who has not decided where he will look for a job should limit his statements to length of employment and other basic facts not open to misinterpretation in later years. He should keep clear of generalizations about abilities and attitudes that can be ascribed to anyone on paper. In all types of references, the writer should keep in mind that he is placing his reputation as a competent judge of character and ability on the line at all times.

Academic references are often the most valuable aid to the employer in rating prospective employees because they are usually specific. The faculty member has had ample time to observe the individual in his ability to adjust himself to the demands of school society, his compara-

tive progress in his studies, and his over-all mental development and maturity. He has academic records to shore up his opinions of the individual's worth, and, best of all, the instructor usually has a genuine interest in the person he is recommending. This is not always the case with other types of references.

Some professors highly placed in the educational world receive numerous requests for references from their former students, and over a period of time such popular faculty members develop a number of well-meaning phrases that they apply indiscriminately to almost any student they are called upon to rate for an employer. This has been, at times, a source of great embarrassment to the Placement Service when two or more candidates for the same job use the same reference person and the employer receives nearly identical recommendations.

THERE are four types of forms used by placement services when furnishing information to prospective employers: *check*, *rate*, *combination*, and *statement*. The *check* form generally poses a series of questions which may be checked with a "yes" or "no," such as, "Is he honest? Is he industrious? Is he tactful?", and so forth. The *rate* form relies on a series of word descriptions of personal qualities and offers an evaluation of the applicant. It contains several spaces or squares after each quality (dependability, self-expression, confidence, etc.) in which the person can be rated in relative terms ranging from "high" or "excellent" to "low" or "poor."

The *combination* form asks the recipient to rate the qualities of a person and also to make additional comments that are pertinent. The *statement* form, which has been in use at the Boston University Placement Service for the past few years, seems to us to be the most effective. It asks the friend, employer, or teacher to express himself at length about the personal qualities, academic achievements, and vocational maturity of the candidate.

Before we accepted the *statement* form for wide circulation, we made a survey among a large number of industrial employers and school officials, and we studied the results. The majority preferred this form which allowed free expression without being restricted to one-word or one-phrase "tag" evaluations.

THE major specific improvement needed in written recommendations is either development or abandonment of the term "personality." The definition of this word differs from one book to another, depending upon whether it is written by a psychologist, a social scientist, or an author describing "how to get ahead in your job." Most people agree that "personality" is the sum total of all a person's attributes and attitudes; but to say in a letter of reference that a man or a woman has a "good personality" is to leave the reader with a very general impression that the applicant is socially acceptable but not necessarily suited to the requirements of the job in question.

WHILE the first reaction of many employers is "references don't mean a thing to me," most of them expect the job candidate to have them on hand or available as a matter of tradition. If an applicant occasionally appears on the scene without the usual fistful of testimonials, most employers, I think, will not hire the man on purely subjective information but will soon consult with previous employers or teachers mentioned during the interview. References *are* necessary, and they *can* be helpful both to the employer in furnishing him the information he needs to make a decision and to the applicant in helping him back up claims made during a personal interview.

The Library of the School of Medicine*

FLORENCE E. TURNER, *Librarian, School of Medicine*

The present Library, with its several reading rooms, represents the progress of the Medical School itself. Its third and most recent move brought it to the second floor of Building A of the Medical School, the former home of the Evans Memorial Hospital. Once there, it profited by the physical set-up of the building to the extent of becoming a modern subject-divisional library. The reading rooms are actually working libraries of the various branches of medicine, for each room is lined with stacks containing the textbooks, monographs, and bound periodicals relating to a particular subject. This arrangement minimizes travel within the Library; it also makes it possible for readers to converse quietly without disturbing persons in other sections. There are separate rooms for reserve material, reference works, and current periodicals. Smoking is permitted in the Current Periodical room and Room 3, where there are man-size ash trays.

Reading Public

This Library "of many parts" is a hospital library as well as a medical-school facility. It is supported by the Evans Memorial Hospital as well as by the University. Its "customers" are the students and faculty of the Medical School, graduate students in the medical sciences, and the staffs and personnel of the Massachusetts Memorial Hospitals and the Fifth and Sixth Medical and Third Surgical services of the Boston City Hospital. About 25 per cent of the student body can be accommodated at one time.

Staff

When the library moved into its present quarters in 1942, the staff comprised one full-time and one part-time librarian. Today, it has four full-time members. The decade 1942-1952 saw a tremendous expansion in the School, and the Library reflects that growth — perhaps more than any other department. Weiskotten in his report on medical education, says: "Perhaps no department is more vital to the educational and research program of the medical school than its library. Indeed, if a medical school were to be appraised by a single criterion, the library might well serve. The library reflects the scientific interest of the faculty, and in the extent to which it is used by students it measures their interest in the study of medicine. . . ."

The staff holds membership in many professional library associations, and its two senior members are "in the process" of certification by the Medical Library Association. The administrator of the Library is most fortunate in her associates. Miss Wilma E. Winters, Assistant Librarian, in charge of reference and inter-library loans, is a veteran of this growing period. Mrs. John Hunter is the cataloguer, and Mrs. Charles Hill is Circulation Librarian.

Facilities and Book Stock

At present the Library contains about 20,000 volumes. It regularly receives nearly 500 current periodicals (in several languages), and recently published books are constantly being added to the collection. All

*This article is reprinted from the December, 1953, issue of the *Boston Medical Quarterly* by permission of the author and of the editor. Copyright, 1953, by Boston University and Massachusetts Memorial Hospitals.

the important medical indices and abstract journals, as well as the Cumulative Book Index, are at hand for consultation. A visible index indicates in what room any journal may be found. This open-shelf library is interpreted to the reader by means of a dictionary catalogue — author and subject in one alphabet, and arranged according to the Boston Medical Library Classification.

Faculty gifts have been very generous. Several men regularly give the Library numerous periodicals and books; if these had to be purchased, they would cost hundreds of dollars. In addition, nearly every student society in the Medical School has assumed the responsibility of at least one journal subscription. A charming kindness frequently shown the Library is the gift of flowers. The Library has a microfilm reader and a microcard reader. A recent acquisition, the gift of the Alethean Club, is a Contoura. This portable photocopying device can be operated by one person and operates under normal artificial lighting conditions; hence exposures may be made wherever the original material is available. A still more recent acquisition is a Verifax Printer — the gift of Dr. Keefer. This machine, produced by the Eastman Kodak Company, makes it possible to photograph and develop in fifty seconds a page of an article, three copies in sixty seconds from the same sensitized sheet.

Services

Reference and Inter-Library Loan. The Library takes especial pride in its reference service, and stands ready to obtain for its readers any reference or bit of information that may be desired. Drawing heavily on the resources of the Boston Medical Library, the Harvard Medical Library and the Armed Forces Medical Library in Washington, this Library in the year 1952-1953 completed 293 inter-library loans. Reference work admits no boundaries; the Library last year went as far afield as London to obtain information for one of its readers. A foreign-born Hospital Resident, about to take his board examination, found it necessary to prove that his medical school taught a given subject for a certain number of hours. His school, now in a Soviet-occupied country, made no reply to the request for a catalogue. A thorough survey of all the likely large medical libraries, as well as the Library of Congress, was unavailing. The search ended with the National Central Library at London shipping the needed catalogue to us. Should the doctor again need this information, he can produce several yards of microfilm — the entire catalogue in a small roll.

Instruction in Medical Bibliography and in the Use of the Library. Each year the Librarian sets up a bibliographical laboratory and in informal groups of fifteen to twenty, introduces first-year and graduate students to the voluminous literature of medicine. This is done in the belief that the student learns far more by handling material and surveying it for its possibilities, under supervision, than through mere notes concerning a given index or reference book. When in his third year the student writes his extensive "Medicine III" paper he puts all his bibliographic "know-how" into practice. New house officers, when first visiting the Library, are also indoctrinated in its systems.

Telephone service. A member of the Faculty or of the Hospital staff may occasionally telephone for the latest information on a particular subject. The librarians then gather together the pertinent volumes and put them in the "Faculty Study," where he may read, dictate to his secretary, or merely collect them to be read elsewhere.

Hours

Nearly eighty years ago the Library published a catalogue of its books, together with rules for the use of the collection. Paragraph 1 of the *Rules* reads as follows: "The Library will be open during the School Term every Saturday from 10 to 12 A.M." These words point up the changes in both medical education and the status of medical-school libraries. Today the Library is open from 8:30 A.M. to 10:00 P.M. Monday through Friday; 8:30 A.M. to 5:00 P.M. on Saturdays and 2:00 to 5:00 P.M. on Sundays through the school year. During the summer, the hours are 9:00 A.M. to 10:00 P.M. Monday through Friday. The Library is also available to hospital personnel after closing time through the Resident in Medicine, who is custodian of a key to the premises.

Exchange

One of the most productive (and time-consuming) activities of the Library is its participation in the Medical Library Association Exchange. As an institutional member it must, in accordance with the Association's by-laws, submit a list of its duplicate material at least once every two years. Last summer the Library sent out from its "dups" 1,737 items to 150 libraries in forty states and eight foreign countries. In turn, through meticulous checking of lists, the Library has considerably augmented its book stock, filled in gaps in periodical files, and even added new journals to which it does not subscribe. The Library would be very happy to receive copies or files of journals (intact, please!) which might be offered on the Exchange.

The Library Committee

During the last decade — the period of the Library's most vigorous growth — the administrator has been fortunate in having the assistance of a very active Library Committee, headed for many years by Dr. Sanford B. Hooker and currently by Dr. Burnham S. Walker. The members of the Committee, who represent both the clinical and the basic sciences, are exceedingly generous with both time and counsel. (The Librarian once mentioned at a Medical Library convention that her Committee met with her once a month. The response was: "Once a month! Why, we have hard work getting ours together once a year!")

Plans for the Future

The Library now occupies the entire second floor of Building A; in 1942 it was expected that these rooms would suffice for many years to come. Alas! It has already outgrown its allotted space and has begun to require compact book storage of some material and dead storage of other. It has been estimated that a scientific library doubles itself, on an average, every sixteen years. This Library will do just that if it continues to grow at the rate it has been achieving these last years. This Library needs new quarters NOW!

Any plans for new quarters must be based on a substantial increase in the size of the classes in the new medical school building. It is also probable that the number of graduate students will increase — and such students do a tremendous amount of library work and require much assistance. Moreover, the hospital is acquiring more and more teaching affiliates, and the needs of this additional reading public must be anticipated. Finally, the development of a university medical center may well bring about a consolidation of library resources; this will necessitate a still larger staff for the assistance of this increased reading clientele and to supervise added space.

A New Computing Service

JOHN E. ALMAN
Director, Office of Statistical and Research Services

Early in March a new research facility became available in the University's Office of Statistical and Research Services. It is the Card Programmed Calculator, made by International Business Machines Corporation. An electronic general-purpose computer, it makes possible the solution of problems that require large amounts of sequential calculations, freeing the research worker for the more important task of evaluation and planning.

Though the spade work on development of electronic computers goes back to the years just before and during World War II, their general availability is wholly a product of the years since the War. These few years have seen a mushrooming of applications for the machines such as to revolutionize methodology in many areas of scientific research and engineering. With the growing complex of scientific research in Boston University, the need for such a computer has grown rapidly, particularly in the Optical Research Laboratory, which provides the contractual support that makes the machine possible. With the advent of this machine, Boston University can offer to its research program computing services of a quality surpassed only by a very few universities in the country.

The principal use of the machine is computation for optical lens design projects in the University's Optical Research Laboratory. Computations consist of tracing the paths of rays of light through a lens system and computing resulting aberrations. For example, a typical job for a 3-element lens, with seven refracting surfaces, involves tracing light rays of three wave lengths and three angles of incidence each, plus skew rays at two different angles each. This requires about thirty man-hours by an experienced lens designer using a desk calculator; the same job requires about two hours of machine time using the CPC. Even more spectacular savings in time are made for more complex lens systems. An indirect benefit is the obvious saving of "wear and tear" on the lens designer, releasing him from the drudgery of repetitive calculations.

While the primary mission of the machine is optical design, a limited amount of operational time is available for other projects. Matrix operations are an example of an area where spectacular savings in time can be made. These operations include matrix multiplication, solution of systems of simultaneous linear equations, calculation of the inverse, the characteristic equation and its roots, and the modal vectors. For example, the solution of a set of seven linear equations in seven unknowns can be performed and checked at the rate of about 4 minutes per set, a task that requires several hours at the desk calculator. Other applications include repetitive evaluation of formulas, numerical integration, interpolation and differencing, and analysis of statistical data.

In general, the machine can handle any computational problem; it is only necessary that the problem be resolved into a series of simple steps involving the four fundamental operations of arithmetic. The machine can also make a logical decision at any stage of a computation by means of an inequality between two numbers. The alternatives to be chosen are normally of the "either-or" variety and must be "programmed" into the machine in advance.

Preparation of a problem for machine solution involves three basic steps. First, the problem must be broken down into calculational steps, each step involving only one operation of arithmetic or logic, and a sample numerical example must be worked out in step-by-step detail. Next, the problem must be programmed for the machine by someone familiar with the code requirements of the computer. Finally, the sample problem is placed in the machine, and the programming previously done is tested and checked. Only then is the actual data ready to go into the machine.

Since the task of programming requires a knowledge of the machine codes, for the present it is necessary that this be carried out by the staff of the Office of Statistical and Research Services. As soon as it is feasible, it is planned to issue a coding manual and provide instruction in its use, so that others may prepare their problems for solution. Since preparation time normally far exceeds running time, the more widespread the knowledge of machine coding procedures, the more efficiently the computer can be used. A "library" of program card decks is in process of preparation for recurrent problems to cut down preparation time. An example of such is the program deck for inversion of a seventh order (or lower) matrix; only the values of the matrix to be inverted are punched into cards for a particular problem.

Physically, the CPC consists of six cable-connected units. These are the No. 605 Computer, the No. 527 Punch, the No. 418 Tabulator, and three No. 941 Storage Units. The Tabulator is the "central switchboard" of the machine. Into it are fed cards containing data and instruction codes. These are relayed to other parts of the machine as necessary, and the results of the calculations are printed as desired. Results may be punched into new cards for later use, or stored in the storage units for further use within the same set of calculations. All arithmetic operations take place in the 605 computer. This unit contains about 1450 electronic tubes, and operations take place at electronic speeds. For example, the multiplication of the 8-digit number, 12345678, by the 5-digit multiplier, 12345, requires about one one-hundredth of a second.

The Computer, the Punch, and the Tabulator are each "programmed" by means of a plugboard wired in similar fashion to the standard IBM punched card machines. Hence, it is possible to build a special machine set-up to handle any particular problem. However, this may involve a tremendous amount of time for planning and wiring; it is preferable to use a general-purpose plugboard set-up that provides for the fundamental operations of arithmetic in a variety of combinations to which are attached pre-determined punched card codes. By planning a problem in the framework of this set-up, much preparation time is saved. The general purpose set-up used on our machine provides for all arithmetic operations, including square root, with all numbers expressed in "floating decimal" notation, i.e., all numbers are expressed in standard form multiplied by the appropriate power of ten, with the exponent being increased by 50 to avoid negative values. For example, the number $123.4567 = 1.234567 \times 10^2$ is written as 12345675 2. Results may be printed in either fixed or floating decimal notation.

Interested persons from within the University or from other institutions are cordially invited to see the machine in operation, and group demonstrations will be arranged on request. The CPC is housed in the machine laboratory in Room 8, College of Liberal Arts, 725 Com-

monwealth Ave., and arrangements for demonstrations may be made in the office of the Director, Room 16.

The cost of computing service depends upon the amount of preparation time and machine running time; estimates will be given by the Director for particular problems. Though the machine has the primary mission of serving University projects, its services will be made available to other institutions as time permits. All requests for information regarding computing services should be addressed to the Director, Office of Statistical and Research Services, Boston University, 725 Commonwealth Avenue, Boston 15, Mass.

Record of Research—XII

The following list of books and articles published recently by members of the University staff or by students was compiled partly from information made available in the offices of the President of the University and of the Dean of the Graduate School, and partly from the *Boston Medical Quarterly*, a publication of the Boston University School of Medicine and the Massachusetts Memorial Hospitals.

Church History

CAMERON, RICHARD M. "The Little Flowers of John Wesley," *Religion in Life*, 23 (Spring, 1954), 267-78.

———. *The Rise of Methodism: A Source Book*. New York: Philosophical Library. [c. 1954.] Pp. xv, 397. $4.75.

Medicine

BOARDMAN, DONNELL W. "The Doctor's Office Laboratory," *M. Clin. North America*, 37: 1565, Sept. 1953.

FINCH, STUART C., ROSS, JOSEPH F., & EBAUGH, FRANKLIN G., JR. "Immunologic Mechanisms of Leukocyte Abnormalities," *J. Lab. & Clin. Med.*, 42: 555, Oct. 1953.

HAMBURGER, M., & LEMON, HENRY M. "The Failure of Antistreptolysin to Protect against Streptococcal Infection," *J. Lab. & Clin. Med.*, 42: 140, 1953.

JUDSON, WALTER E. "Hypotension: Physiologic Mechanisms and Treatment," *M. Clin. North America*, 37: 1313, Sept. 1953.

KRAMER, PHILIP, & FUCHS, BERTRAM. "Acute Liver Disease: Its Causes and Treatment," *M. Clin. North America*, 37: 1379, Sept. 1953.

LOWELL, FRANCIS C. "The Prevention and Treatment of Drug Allergies," *M. Clin. North America*, 37: 1409, Sept. 1953.

SCHILLER, IRVING W., BOGER, W. B., SHERMAN, W. B., SIEGAL, S., & ROSE, B. "Allergic Reactions to Penicillin," *J. Allergy*, 24: 388, Sept. 1953.

STRAUSS, MAURICE B., & BIRCHARD, WILLIAM H. "Factors Influencing the Diuretic Response of Seated Subjects to the Ingestion of Isotonic Saline Solution," *J. Clin. Investigation*, 32: 807, Sept. 1953.

WEINSTEIN, LOUIS. "Antigenic Dissimilarity of Streptokinases," *Proc. Exper. Biol. and Med.*, 83: 689, Aug.-Sept. 1953.

———. "What the Practitioner should know about Poliomyelitis," *Rhode Island M. J.*, 36: 361-7, July, 1953.

WEINSTEIN, LOUIS, GOLDFIELD, MARTIN, & ADAMIS, DIONYSIUS. "A Study of Intrathecal Chemotherapy in Bacterial Meningitis," *M. Clin. North America*, 37: 1363, Sept. 1953.
WILKINS, ROBERT W. "Hypertension: Recent Trends in Treatment," *M. Clin. North America*, 37: 1303, Sept. 1953.
WILKINS, ROBERT W., and STANTON, JOSEPH R. "Elastic Stockings in the Prevention of Pulmonary Embolism. II. A Progress Report," *New England J. Med.*, 248: 1087-90, June 25, 1953.

Music

CHOATE, ROBERT A. "Music Education," *Higher Education*, 10 (1953), 53-61.
GEIRINGER, KARL. *The Bachs: A Family Portrait.* (University Lecture, April 21, 1953.) Boston: Boston University Press. 1953. 23 pp. 50c.

Nursing

BEAL, LUCY H. (ed.). *Case Studies in Nursing Service Administration.* Collected and Compiled by Faculty and Graduate Students in Nursing Service Administration Boston University School of Nursing. Volume I. Boston: Boston University Press. 1954.

Philosophy

BERTOCCI, PETER A. "Edgar Sheffield Brightman," *The Personalist*, 34 (Autumn, 1953; Edgar Sheffield Brightman Number), 358-9.
KNUDSON, ALBERT C. "Brightman: A Personal Word," *ibid.*, 365-6.

Physics

KEELAN, HARRY S. "Photographic Monobaths for Rapid Processing," *Photographic Engineering*, 4 (1953), 157-161.
MACDONALD, DUNCAN E. "Air Photography," *Journal of the Optical Society of America*, 43 (1953), 290-8.
———. "Resolution, Sharpness, and Picture Quality," *Photographic Society of America Journal*, 19B (May, 1953), 49-54.
PESTRECOV, KONSTANTIN. "Development of the ER-Projector," *Science*, 118 (October 23, 1953), 492-3.
———. "Visual Tasks in Aerial Mapping with Multiplex Equipment," *American Journal of Optometry*, 30 (July, 1953), 366-73.
SIEGEL, ARMAND (co-author with NORBERT WIENER). "A New Form for the Statistical Postulate of Quantum Mechanics," *Physical Review*, 91 (September 15, 1953), 1551-60.

Preventive Medicine

BAKST, HENRY J. "Domiciliary Medical Care and the Voluntary Teaching Hospital," *Am. J. Pub. Health*, 43: 589-595, May, 1953.
———. "Medical Care: Symposium on Extra-mural Facilities in Medical Education," *Journal of Medical Education*, 28 (July, 1953), 40-3.
BONNET, PHILIP D. "Doctors and Hospitals," *Rhode Island M. J.*, 36: 442, Aug. 1953.

Speech

FREELEY, AUSTIN J. "An Examination of the Status Quo," *The Gavel*, 36 (Nov. 1953), 8-12.
———. "Minimizing Educational Opportunities," *Speech Activities*, 9 (Autumn, 1953), 67-70.

The Preparation of Science Teachers

JOHN G. READ, *Professor of Education*

Note: Writing in the March JOURNAL *on "Tomorrow's Science Teachers," Dr. Read emphasized the present shortage of science teachers in the secondary schools. In the following article, he deals with some of the problems incident to the adequate preparation of science teachers.*

As was true of the previous article, the material here is largely from the booklet Critical Years Ahead in Science Teaching: Report of Conference on Nationwide Problems of Science Teaching in the Secondary Schools Held at Harvard University...July 15 to August 12, 1953. *48 pp.**

Dr. Read was one of the twenty-two educators who were invited to participate in this Conference that was made possible by a grant from the Carnegie Corporation of New York. Professor Fletcher G. Watson of the Harvard Graduate School of Education was moderator and was one of the editors of Critical Years. *An article by him appeared in the February, 1954, issue of the* Scientific Monthly, *entitled "A Crisis in Science Teaching," and this reports the facts in more detail than is possible here.*

The bracketed numbers following certain paragraphs in this article indicate the excerpted pages of Critical Years; *paragraphs without such numbers are Dr. Read's interpolations.*

"Qualified"

About one-fifth of all high school teachers, 67,000 among 325,000, meet one or more science classes. In the annual new-teacher group, only about nine percent are qualified to teach one or more of the sciences!

What does "qualified" mean? First, to answer critics who say that education courses take up too much time in college, here is the evidence to the contrary, Table VIII, p. 27, of *Critical Years:*

"Frequency of Semester Hours of Study in Education required for Certification in 48 states and the District of Columbia":

SEMESTER HOURS	FREQUENCY
Less than 18	12
18	21
19-23	10
24	6
More than 24	0

This total requirement for professional study of education represents less than the 30 to 32 semester hours credited for one full year of collegiate study. ..... Realistically, such vocationally-oriented study is a modest investment made by the student while preparing for the complexities of his life's work as a teacher. [27]

Great diversity exists among the states in the subject matter requirements for certification of science teachers. For instance, 13 states established rather specific course requirements; of these, 10 established a minimum of semester hours in biology, physics, and chemistry. In 29 states, it appears to be possible to be certified to teach in one science field without having college credit in any other science. Five states require certification in a comprehensive area, including "all sciences," or under such groupings as "biological or physical sciences." [27, 28]

It is difficult to give an accurate picture of subject matter requirements in the various states without listing them. The complete data are available.[1] Only Arizona, California, the District of Columbia, New York,

*Copies of this booklet may be obtained by sending a self-addressed label to Mr. Elbert C. Weaver, Phillips Academy, Andover, Mass.

Oregon, and Washington say they require five years of preparation to teach in senior high school. Excepting California, no state requires more than 24 semester-hour credits in the major science. (California requires 36 in the five-year program.) The modal requirement is near 18 semester hours. In addition, a science or mathematics minor may be required. (At Boston University, majors in science education are required to have 18 hours in one science, 12 in another, and at least one year of a third science. Mathematics through differential calculus is required of chemistry and physics majors. Grades of B- in 18 hours of science are necessary for graduation.) There are a few states which require some special course: Wisconsin requires one in conservation; California, a course in personal and community hygiene. In general, any student completing four years of science work, with some distribution between two areas and with two courses in a third science, will find himself prepared to satisfy teaching-certificate requirements.

"Quality"

Second, "qualified" implies "quality." How well are the science teachers of the nation prepared in their subjects?

Many high school science classrooms are staffed by teachers who do not meet minimum legal certification requirements. This situation may result from unavoidably poor utilization of science teacher talent or from a dire shortage of qualified science teachers. It is a sad truth that many legally-qualified science teachers do not teach science. They may teach other courses instead of a science, or they may have been attracted into educational administration. Also, as mentioned before, the higher salaries available in industrial technology may have drawn such teachers away from teaching. [28]

Studies in Alabama, California, Massachusetts, Nebraska, Pennsylvania, Texas, and Utah, sampling the teachers of all the sciences, support the statement about science teachers who do not meet minimum *legal* requirements of the states in which they teach.

The preceding statistical summaries [pp. 29-35 of *Critical Years*] and the original reports permit certain generalizations about the present status of science teacher preparation:

a) a considerable minority of science teachers (particularly in smaller schools) are not certified in science;
b) a significant portion of teachers who are certified in science have relatively meager backgrounds in this area;
c) a fairly large number of science teachers have their science training concentrated in one area, to the near exclusion of other areas;
d) many teachers certified in science spend all or part of their time teaching non-science classes or engaging in other types of educational activity;
e) teachers of General Science tend to have less thorough backgrounds than those who teach special science subjects;
f) there is a tremendous range both in the scientific and the professional educational backgrounds of the nation's science teachers;
g) a considerable percentage of science teachers have graduate degrees or have done graduate work in science and education;
h) in general, the science teachers in larger schools tend to be better prepared than those in smaller schools. [35, 36]

Who Teaches Science in the Schools?

Commenting upon the difficulties of defining "shortages" of teachers, on page 145 the authors of *A Policy for Scientific and Professional Manpower*,[2] wrote: "Very few classrooms have

been closed because a teacher is unavailable. When a teacher with the desired qualifications is not available, someone with lesser qualifications is hired. Thus, a shortage of teachers is manifested by the inability of the schools to secure teachers who meet established qualifications." Later, on page 215, the consequence is pithily stated: "Every community can get enough teachers by compromising its standards of quality." [37]

What May Be Done?

If ill-qualified teachers are here to stay (and the meager supply and rising demand certainly look that way), what can be done to minimize, at least, the psychological and physical dangers which may accompany poor science teaching? There are at least six ways by which palliative action can begin:

a) ill-qualified teachers can be assisted through a supervised program carefully designed to present new ideas and information to all the science teachers;
b) ill-qualified teachers can be required to participate in a program of in-service training consisting of summer schools, workshops, extension courses, or correspondence courses;
c) non-certified teachers can be required to visit and observe good teaching procedures demonstrated by qualified science teachers;
d) qualified science teachers can be assigned a full load of science teaching only;
e) emergency teachers can be required to take needed additional training before their certificates are renewed;
f) teachers can be encouraged to participate in the activities of professional organizations of science teachers. [37, 38]

General Recommendations

During the last twenty years certain criteria for adequate preparation of science teachers have been proposed by individuals and groups which included academic people, scientists and educators. In about twenty such reports[3] there is concurrence on seven general recommendations. These, as listed below, might well be considered by those attempting new steps in the development of teacher certification requirements and teacher training programs. There is concurrence that:

1) required programs and the courses composing them insure that the prospective teacher has a scholarly mastery of the fields to be taught;
2) the prospective teacher have a knowledge of education, including such aspects as the nature and development of the child and adolescent learner, testing methods, and evaluation;
3) skill and competence in teaching be developed as far as possible through realistic experience with actual problems which arise in schools and communities;
4) the prospective teacher have contact with all major areas of human knowledge. Specialization is not enough. The teacher should become aware of the interactions of his major field of study with other fields of human endeavor and creative thought;
5) the five-year college training program for teachers become a mandatory minimum;
6) nation-wide or at least regional standards for teacher certification be adopted, and better methods of appraising teacher competence be found;
7) during the training process, a sense of self-criticism be instilled in the prospective teacher, so that later he may have the ability to evaluate himself and his work. [39, 40]

There are, however, some problems associated with the five-year program for science teacher preparation. Teachers who aim at the Master

of Arts or Science degree often find that their background in a particular subject is insufficient to allow them to enroll in graduate courses, or to compete with undergraduates who have completed far more semester hours of study. Such courses, designed for the future specialist in a field, may have less usefulness to a teacher than would similar courses designed explicitly for teachers. There are also problems raised by time and money. Lack of time often makes it difficult for an employed teacher to carry through an investigation meeting degree requirements, while lack of funds often prohibits the teacher from investing another year or more in full-time graduate study. [40, 41]

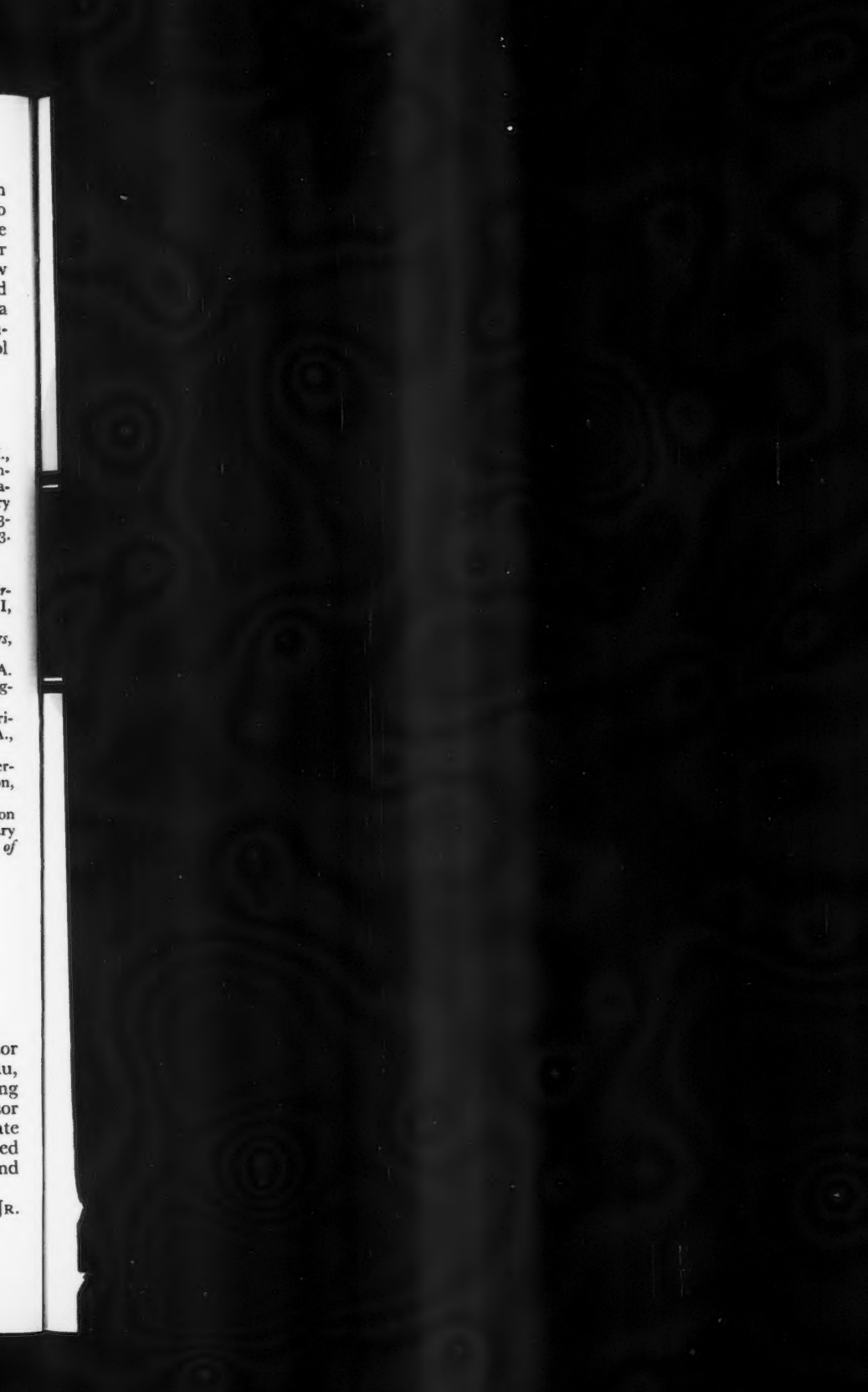
It is important that our scientists and industrialists as well as our educators, become actively sympathetic with the problems involved in encouraging and training competent young people for teaching science in the schools. For want of a few thousand competent new science teachers each year, science instruction may necessarily be radically reduced in the schools. Or the instruction offered may be such a caricature of science that promising students turn elsewhere through boredom or even develop a repugnance toward science. [41]

We need teachers who have an awareness of scientific problems, who grasp every opportunity to encourage an inquisitive pupil toward further study and investigation, who know how to direct laboratory work and student projects, and who have a desire to make science classes a stimulating part of every high school curriculum. [41]

References

1. Woellner, Robert C., Wood, Aurilla M., "Requirements for Certification of Teachers, Counselors, Librarians, Administrators for Elementary Schools, Secondary Schools, Junior Colleges," 18th ed. 1953-54, University of Chicago Press, April 1953.
2. Columbia University Press, 1953.
3. Among these reports are:
   Program for Teaching Science, *31st Yearbook of the Nat. Soc. for Study of Educ.*, Part I, U. of Chicago Press, 1932.
   National Survey of the Education of Teachers, U. S. Off. of Educ., Bull. 10, 1933.
   Education for ALL American Youth, N.E.A. Education Policy Commission, Washington, D. C., 1944, p. 368.
   The Education of the Science Teacher, American Council of Science Teachers, N.E.A., Washington, D. C., 1942, p. 29.
   The Improvement of Teacher Education, American Council on Education, Washington, D. C., 1946, p. 112.
   Lark-Horowitz, K., "On the Preparation and Certification of Teachers of Secondary School Science", *American Journal of Physics*. 11, 41-2, 1943.

Notes on the African Research and Studies Program

The Program received one eminent visitor during March — Professor Roger Le Tourneau of the University of Algiers. Professor Le Tourneau, a specialist in the history of the Moslem West, is one of the outstanding authorities on sociological and political questions in North Africa. Professor Le Tourneau was in Boston under the auspices of the French Consulate General. He was entertained at lunch by the Program Staff; and he addressed the Seminar in Contemporary Africa on "Traditional Bourgeoisie and Modern Bourgeoisie in North Africa."

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